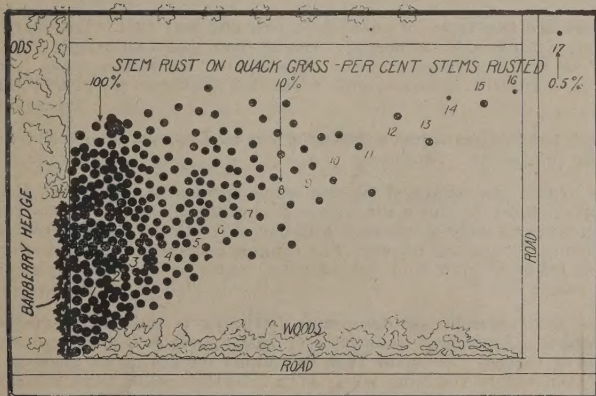


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Stem Rust of Grains and the Barberry in Wisconsin

A. G. JOHNSON AND JAMES G. DICKSON



THE COMMON BARBERRY SPREADS STEM RUST

The stem rust spread from the infected barberry hedge to the grass in the adjoining field. All of the grass plants were rusted near the hedge. Therefore, the common barberry is dangerous and should be eradicated.

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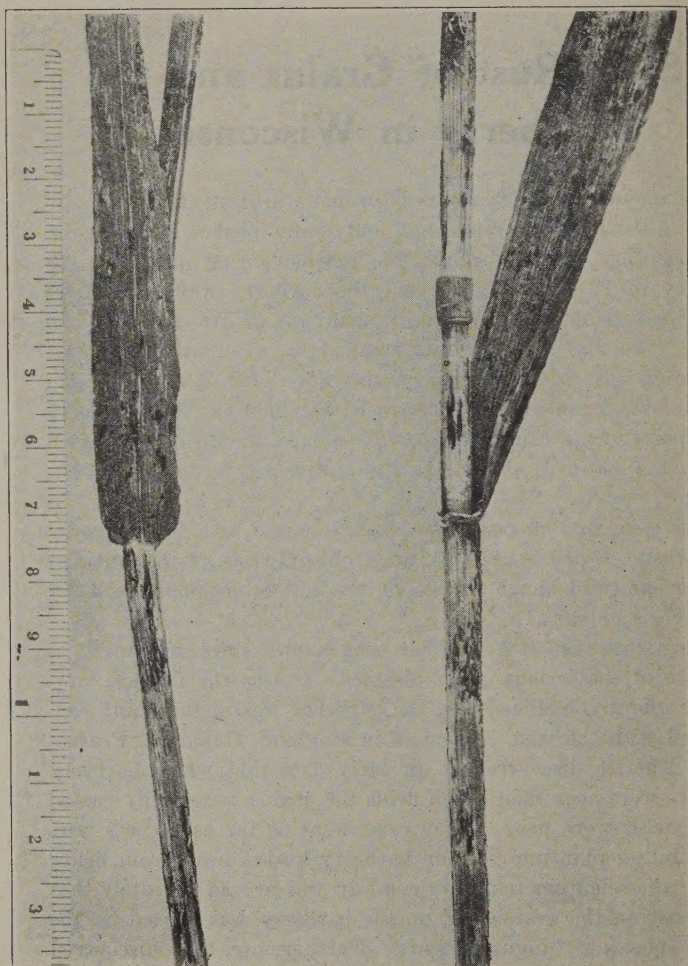


FIG. 1.—THE STEM RUST SPLITS THE SURFACE OF THE STEM AND LEAVES

The stem rust appears on the leaves and stems of barley, oats, wheat, rye and some grasses.

THERE ARE TWO TYPES OF RUST ON GRAINS

The various rusts of grains and other plants are caused by minute plants called fungi. The fungi grow within the grain plants somewhat similarly, in general, to the way the grain plants grow in the soil. Growing in this way, these rust fungi so sap the vitality or poison the tissues of the grains as to cause the diseases popularly known as the rusts.

In addition to the stem rust, which may occur on any of the cereals, there are leaf rusts, which also occur on the various grains. These leaf rusts are often confused with stem rust. They are, however, entirely different, and are caused by other species of rust fungi. None of these leaf rust fungi attack the barberry.

Each of these various cereal rusts has two so-called stages on the grains, namely, the "red rust" or summer stage and the "black rust" or winter stage. The "red rust" or summer stage occurs on the younger growing grain, while the "black rust" or winter stage develops later on the older grain, straw and stubble.

Only certain grains and grasses are attacked by the "red rust" stages of each of the various grain rusts. It is this stage of the rust that during the summer spreads the infection in the fields from the rusted grain and grass plants to those not rusted.

While the "red rust" stages of the various rusts spread the infection among the plants upon which they occur and also to certain other grains and grasses, these stages cannot infect the barberry or other similar plants. Only the "black rust" stages can do this. And in turn, the "black rust" stages cannot directly infect grains or grasses. These stages infect only other plants, widely different from those upon which they are produced, and from the infections on such plants the rusts may spread back to the grains and grasses again. For example, the "black rust" stage of the stem rust of grains (*Puccinia graminis*) lies dormant through the winter and infects the common barberry in the spring. From this barberry infection the rust spreads back to the grains and grasses. Similarly the "black rust" stage of the leaf rust of oats infects the common buckthorn (*Rhamnus cathartica*) and closely related plants. The "black rust" stage of the leaf rust of rye is able to infect

still another plant. The plants that the "black rust" stages of the leaf rusts of wheat and barley may infect are not known.

LEAF RUSTS OF GRAINS CAUSED BY DIFFERENT FUNGI

The leaf rusts of grains are each caused by different but closely related rust fungi. Each of these fungi is able to attack

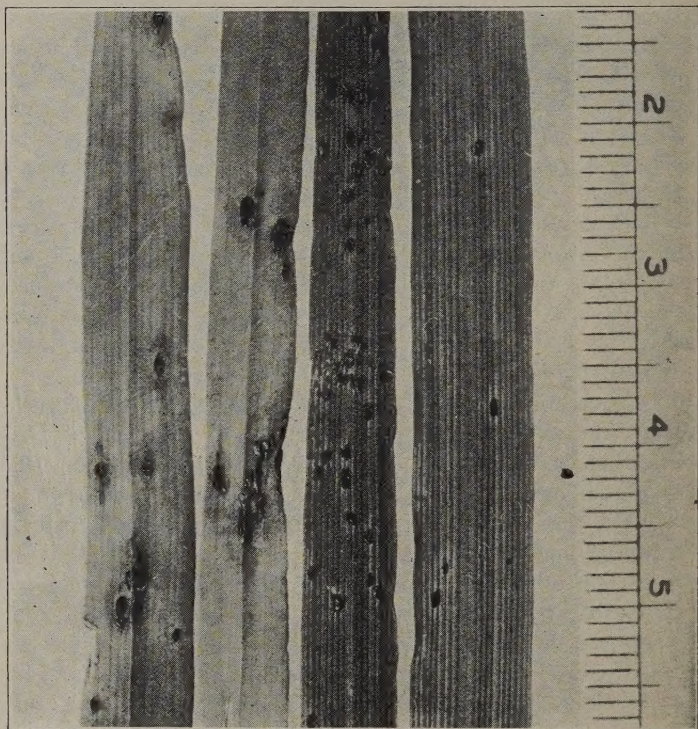


FIG. 2.—THE STEM RUST AND LEAF RUST ARE DIFFERENT

The stem rust on the leaves of winter rye (left) causes long lesions and splits the surface of the leaves. The leaf rust (right) causes small round lesions and does not split the leaf surface.

and cause rust on only the one grain. The leaf rust of rye attacks rye and no other grain, that of wheat attacks wheat and no other grain, and so on. The leaf rusts differ in a number of ways from stem rust. The leaf rusts, as their name suggests, occur chiefly on the leaf blades and leaf sheaths. The "red

rust" stages consist of small, almost circular pustules filled with an orange yellow powdery substance, the spores of the fungi. The leaf rusts do not split the surfaces of the leaves and sheaths so conspicuously as does the stem rust. The "black rust" or winter stages occur on the leaf blades and sheaths and are evident as rather small, smooth, grayish-black spots. These do not break through the surface as does the corresponding stage of the stem rust, figure 1. The differences between the "red rust" stages of the leaf rust and stem rust on rye are shown in figure 2.

BARBERRY SPREADS THE STEM RUST OF GRAINS

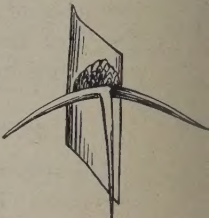
The stem rust of all the grains is caused by the same species of fungus (*Puccinia graminis*). Most of the grains, however, have a so-called specialized strain of the fungus which is able to attack only a limited number of grains and grasses. For example, the stem rust strain on rye, barley, quack grass, and certain other grasses cannot attack wheat or oats. The stem rust strain on wheat attacks wheat, barley, squirrel-tail grass, and certain other grasses, but cannot attack rye or oats. Similarly, the stem rust strain on oats attacks oats and certain grasses, but cannot attack rye, wheat, or barley. Barley is the only grain, then, that is subject to the attacks of more than one of these stem rust strains, for both the rye and wheat strains may attack barley. On the other hand, barley is the only grain which does not have a stem rust strain specialized chiefly to itself.

All of these various specialized strains of stem rust can infect the common barberry in the spring by means of their "black rust" stages. And then in turn, each strain can spread from the barberry back to the same grain or grains and grasses to which it is specialized. That is, its specialization remains the same, even after infecting the barberry.

The "red rust" stage of stem rust occurs chiefly on the stems (fig. 1), but may also occur on the leaves of the growing plants (fig. 2). It is evident as rather conspicuous, distinctly elongate or oblong, reddish-brown pustules. These pustules are quite

The leaf rust of rye is caused by the fungus known by its Latin name as *Puccinia dispersa*; the leaf rust of wheat by *Puccinia triticea*; the leaf rust of oats by *Puccinia coronata*; and the leaf rust of barley by *Puccinia simplex*.

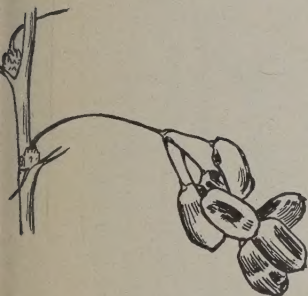
TABLE II.—DISTINGUISHING CHARACTERISTICS

Kind of barberry	Habit of growth	Color of bark	Shape of spines
HARMFUL Common or tall European Barberry	Tall upright open habit of growth	Gray	Three-parted, large 
HARMLESS Japanese Barberry	Low, rather spreading dense habit of growth	Reddish brown	Simple, small 

HARMFUL AND HARMLESS BARBERIES

Description
of berries

Oblong, shriveled,
red to purple,
borne in long clusters



Description
of leaves

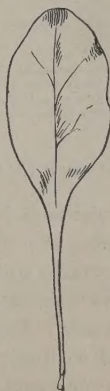
Rather large,
sharply toothed
margins



Oval, plump, scarlet,
borne singly or in pairs



Rather small,
smooth margins



large and, as they break through the surface of the stem or leaf, cause marked splitting of the surface layers. This splitting and shredding of the surface is likewise characteristic of the "black rust" stage, which develops later in the season in the same or adjoining regions formerly occupied by the "red rust" stage.

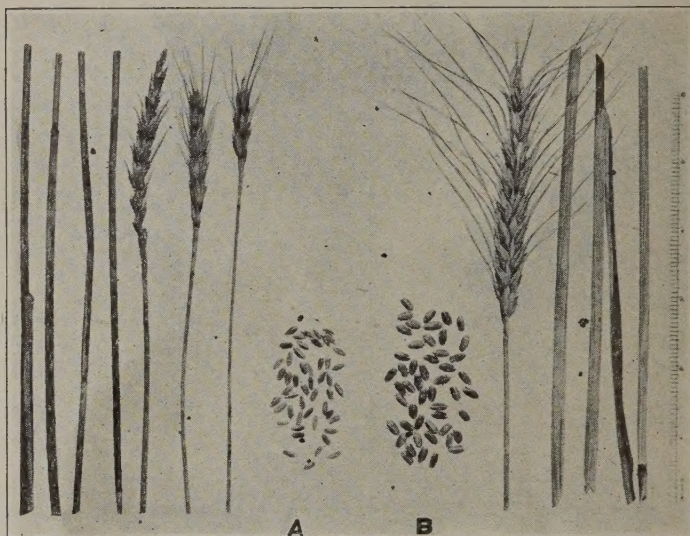


FIG. 3.—THE STEM RUST CAUSES SMALL HEADS AND BADLY SHRIVELED GRAIN

The wheat heads shown at A were collected near a barberry bush where the rust was very heavy. The heads are small, the straw is poor, and the grain is light and shriveled. The head shown at B was from a portion of the field free from rust. The heads are large, the straw is clean, and the grain plump and heavy.

HEAVY DAMAGE DONE BY VARIOUS RUSTS

The annual losses from stem rust attacks on grains are enormous. Briefly, the disease affects the crop as follows: The stem rust actually splits the stems of the growing grain plants, which breaks the outer layers and allows a large amount of water to escape. Experiments have shown that wheat plants badly rusted with stem rust require about one-third more water than similar non-rusted plants. Besides this loss of water, the fungus causing the rust feeds on the stem of the growing plant just below the head and robs the plant of the food which should

normally go to the head to form plump heavy kernels. Thus, as is well known, the grain from badly rusted plants becomes greatly shrunken (fig. 3). The leaf rusts, on the other hand,

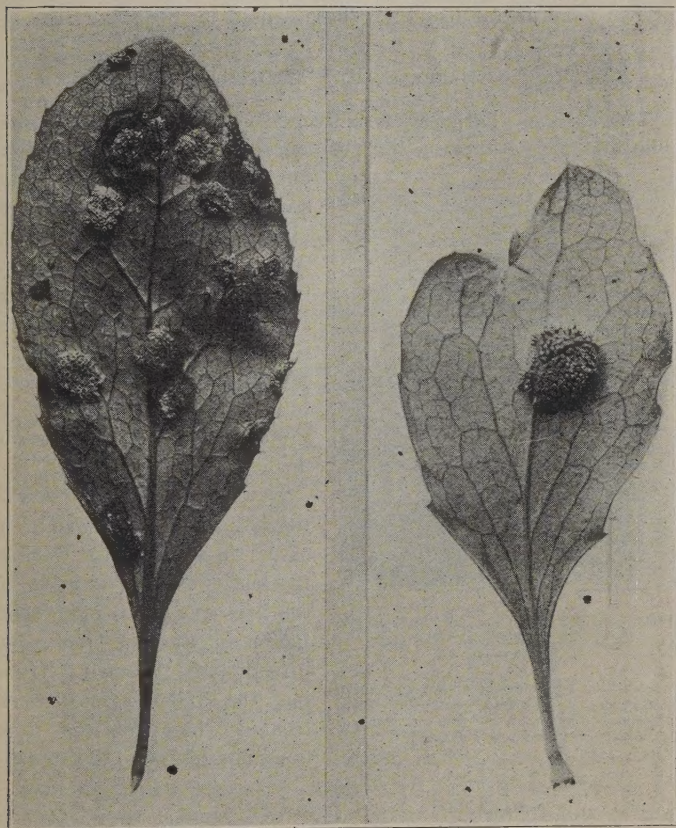


FIG. 4.—THE STEM RUST FORMS CLUSTER CUPS ON THE LEAVES OF THE COMMON BARBERRY

The cluster cups of the spring stage of stem rust appear on the under surface of the common barberry leaves and spread spores to the surrounding grains and grasses. The large cluster cup on the right is magnified in fig. 6.

do not cause nearly so severe injuries. They split the leaves and sheaths but very little or not at all and, therefore, do not cause a large loss of water. They do not occur on the stem to any extent and, therefore, do not rob the plant of the food

which is in the stem ready to be sent to the filling head. The slight loss caused by the leaf rusts is due to a small loss of water by the plant and small losses of food. Experiments and observations have shown that the losses caused by the leaf rusts are, in general, far less than those caused by the stem rust.

RELATION OF BARBERRY TO STEM RUST IN WISCONSIN

The common barberry is universally rusted in Wisconsin. The first appearance of the rust on the barberry is generally about the first of May and spore production continues until the latter part of June. A few barberry leaves carrying a normal rust infection are shown in figure 4. The single cluster cup, or so-called aecium, (fig. 5) contains enough rust spores to sow rust over a 40-acre grain field.

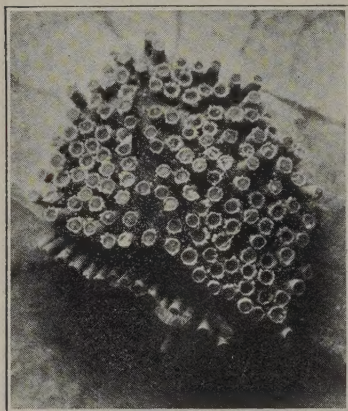


FIG. 5.—CLUSTER CUP OF THE STEM RUST ON BARBERRY HIGHLY MAGNIFIED

Each little cup contains spores enough to sow stem rust on an acre of grain. There are spores enough on the whole cluster cup to spread rust over a 40-acre field.

Extensive field observations and field tests have been made in Wisconsin during the last two years to learn if the barberry is an important factor in starting stem rust infections in the spring. During the fall, regions were located where the rust was abundant. Definitely marked locations on grasses were carefully observed throughout the winter and following spring. Careful search at these stations gave no evidence of new stem rust infections previous to the time when such infection could have come from rusted barberries.

Further careful observations on the winter stage of the rust on grasses and grains showed that about 18 days after the winter spores began to germinate in the field, rust infections appeared on the barberry. After the barberries showed the rust,

the rust infections were first noted uniformly on the grains and grasses near infected barberries.

Numerous cases were observed to note the spread of the rust from infected barberries to grains and grasses. In one of these cases, there was a hedge of barberries heavily infected with rust near a quack grass meadow. In this meadow early in the season the rust was very abundant on the quack grass near the barberries and became less and less abundant away from the barberries. Careful counts were made of the actual proportion of rusted and non-rusted grass stems at various locations and distances from the infected barberries. The results are given in Table I and in the figure on the cover.

TABLE I.—SPREAD OF STEM RUST TO QUACK GRASS FROM RUSTED BARBERRY HEDGE

Station number	Direction from barberry	Distance from barberry	Per cent of grass stems infected
1.....	NE	15 feet	100
2.....	NE	40 "	95
3.....	NE	65 "	80
4.....	NE	90 "	30
5.....	NE	125 "	41
6.....	NE	150 "	15
7.....	NE	175 "	10
8.....	NE	200 "	10
9.....	NE	225 "	5
10.....	NE	250 "	2
11.....	NE	275 "	2
12.....	NE	300 "	1
13.....	NE	325 "	1
14.....	NE	350 "	0.5
15.....	NE	375 "	1
16.....	NE	400 "	0.5
17.....	NE	425 "	0.5

It was strikingly evident, as shown in Table I and the figure on the cover, that the rust spreads from the barberry.

Similar observations were also made in grain fields near barberries with similar results in all cases.

Observations and results have been made repeatedly in other states and in other countries, showing that there is undoubtedly a direct relation between the rust infections on the barberry in the spring and the spread of the rust to grains and grasses. The observations in this state show that this is particularly true in Wisconsin. Hence, the barberry should be eradicated.

THREE DIFFERENT KINDS OF BARBERRY COMMON IN WISCONSIN

There are a large number of different barberries described and grown, but only three species have been commonly planted in Wisconsin. The common or tall European barberry (*Ber-*



FIG. 6—COMMON AND JAPANESE BARBERRY ARE DIFFERENT

The common or tall barberry (fig. A) has coarse, grey stems, usually three-parted spines, and the berries in long drooping bunches like currants. The Japanese barberry (fig. B) has brown slender stems, usually single spines, and plump berries singly or in small and short clusters of two, like gooseberries.

beris vulgaris) with green leaves, and the variety with purple leaves (*purpurea*) have been planted quite commonly not only in cities and villages, but also on many of the Wisconsin farms. This species has escaped from cultivation in at least nine different places in the state. The common barberry helps to

spread stem rust and, therefore, is dangerous. The Mahonias, chiefly *Mahonia aquifolium*, have been planted in a few locations. Certain of the Mahonias harbor the stem rust and are, therefore, harmful. Finally, the Japanese barberry (*Berberis Thunbergii*) has been used in nearly all of the parks and many of the residence grounds in the state. The Japanese barberry does not carry the stem rust and, therefore, is harmless.

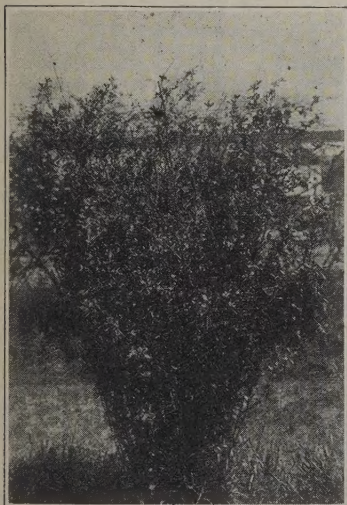


FIG. 7.

THE DANGEROUS BARBERRY

THE HARMLESS BARBERRY

The tall barberry (left) helps to spread stem rust, is dangerous and should be destroyed. The low Japanese barberry (right) is harmless and may be grown.

THE HARMFUL COMMON OR EUROPEAN BARBERRY

The common or tall European barberry varies greatly, yet it is readily recognized. It is a rather tall, upright or slightly arching, spiny shrub, with gray branches which have four grooves running the entire length of each branch (fig. 7.) The spines are usually three-parted at each leaf bud (fig. 6 A). Occasionally, however, simple spines occur. Several other species of plants have three-parted spines, as, for example, the wild gooseberry, but these plants, instead of being smooth-stemmed as the barberry is, have a mass of small hairs covering the surface of the stem. The oblong red berries hang in long clusters and are shriveled and wrinkled in the winter and

spring (fig. 6 A and figure in Table II). The leaves have toothed margins. (See figure in Table II). The purple-leaved, common, or tall, European barberry is identical with the green-leaved form except in the color of the leaves.

THE MAHONIA

The Mahonias are not very common in Wisconsin, as they winter-kill badly. They are low shrubs with spineless branches and compound coarsely and sharply toothed leaves. The round blue berries hang in long clusters.

THE HARMLESS JAPANESE BARBERRY

The Japanese barberry is a rather low, somewhat spreading, dense-growing, spiny shrub (fig. 7) with reddish brown branches. The spines are rather small and usually simple, but with occasional small side spines (fig. 6). The plump, oval, scarlet berries hang singly or in pairs (fig. 6 B and figure in Table II). The leaves are rather small with entire margins. (See figure in Table II.)

